Tobacco Smoking As An Index of Military Personnel Quality

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Previous studies indicate that smokers attrite from military service at significantly higher rates than nonsmokers. The purpose of the current effort is twofold: (a) to examine the implications of treating smoking status as a third military accession quality indicator along with educational credential and mental ability, and (b) to explore preservice psychosocial and health differences between smokers and nonsmokers in support of hypothesis development about reasons for elevated attrition rates in smokers. The results indicate that individuals who smoke tobacco prior to entering military service are almost twice as likely to attrite as nonsmokers, even after statistically controlling for education and mental ability. Moreover, smokers report higher rates of psychosocial and health problems prior to military service. These results support using smoking status as a personnel quality indicator for recruiting and assignment purposes and indicate that smokers, as a group, enter the military with identifiable psychosocial and physical vulnerabilities.

What background factors signify a high-quality applicant for military service? Applicants' educational credentials and mental ability scores are among the primary characteristics considered by military recruiters, and these variables also serve as the key manpower quality benchmarks in Department of Defense (DoD) status reports to Congress (e.g., Cohen, 1999). High school diploma graduates are targeted for recruitment based on extensive evidence that failure to graduate is linked with military attrition (expulsion; e.g., Booth-Kewley, Larson, & Ryan, 2002; Buddin, 1984; General Accounting Office, 1998; Talcott, Haddock, Klesges, Lando, & Fiedler, 1999). Thus, high school dropouts are treated as a separate category for recruiting purposes, and Congress has placed limits on their number to prevent degradation of military readiness. Similarly, the mental ability of military recruits is

reported in categories, and goals are set for the recruitment of "upper mental ability" personnel, defined as mental ability at or above the 50th percentile as measured by the Armed Forces Qualification Test (AFQT; Kilburn, Hanser, & Klerman, 1998). These recruitment goals are justified by evidence linking relatively higher mental ability to effective performance (General Accounting Office, 1998).

Would DoD be justified in using additional variables, in conjunction with high school graduation and mental ability, as broad indices of personnel quality and potential applicant value? The premise of the current article is that tobacco smoking deserves consideration as an additional quality benchmark for several reasons. First, the U.S. military suffers severe financial impacts from tobacco use. Using methodology developed by the Centers for Disease Control and Prevention, Helyer, Brehm, and Perino (1998) estimated that smoking inflates DoD health care costs by $584 million annually and creates an additional $346 million in annual costs from lost productivity. A second reason for highlighting applicants' smoking status is that many studies link smoking to attrition and other adverse personnel outcomes (Gunderson & Arthur, 1969; Knox, 1998; Talcott et al., 1999), further suggesting that smoking status be considered during recruiting.

Quester (1999), for example, examined relationships between smoking and Navy recruit attrition and found an attrition rate of 15% among smokers versus approximately 8% in nonsmokers. Extrapolating from her results, Quester concluded that 1,500 more recruits would graduate from basic training in a 15-month period if the Navy could recruit only nonsmokers. Ryan et al. (2000) also reported that smokers have significantly higher Navy basic training attrition rates, and Booth-Kewley et al. (2002) found that smoking was one of several variables that predicted attrition in the first year of service, even after other predictors were statistically taken into account. Moreover, Navy findings are consistent with Air Force studies on tobacco. Klesges, Haddock, Chang, Talcott, and Lando (2001) reported that smoking predicted first-year discharge from Air Force training better than did other predictors such as demographics, education, or even alcohol intake or attitudes toward drug use. Klesges et al. (2001) estimated that recruits who smoke in the Air Force are associated with $18 million per year in excess training costs; further, across all of DoD, smoking is associated with over $130 million per year in excess training costs.

One possible reason for the link between smoking and military attrition is that tobacco use is more prevalent in populations with poor mental health (Black, Zimmerman, & Coryell, 1999). For example, Gunderson and Arthur (1969) found that a question about smoking was one of 7 items that significantly differentiated between 630 Navy psychiatric patients and 454 healthy enlisted men (controls). Gunderson and Arthur's finding is supported by nonmilitary research as well. Lasser et al. (2000) found that current smoking rates for individuals with no mental illness, lifetime mental illness, and past-month mental illness were 22.5%, 34.8%, and 41.0%, respectively. Their study, based on a representative sample from the

National Comorbidity Survey, concluded that persons with mental illness are about twice as likely to smoke as other individuals. Similarly, in a study on the relation between smoking and suicides rates, Miller, Hemenway, and Rimm (2000) found that the relative risk of suicide was 1.4 times among former smokers, 2.6 times among light smokers, and 4.5 times among heavy smokers (compared to individuals who never smoked). Other studies have linked smoking to anxiety disorders (Johnson et al., 2000), school truancy and family dysfunction (Tomori, Zalar, Plesnicar, Ziherl, & Stergar, 2001), depression (Dierker, Avenevoli, Stolar, & Merikangas, 2002; Goodman & Capitman, 2000), substance use disorders (Substance Abuse and Mental Health Services Administration, 2001; Tomori et al., 2001), panic attacks (Goodwin & Hamilton, 2002), and general emotional distress (Orlando, Ellickson, & Jinnett, 2001).

Given the evidence that smokers are, on average, less mentally healthy than nonsmokers, the fact that smokers have higher rates of absenteeism (Burton, Conti, Chen, Schultz, & Edington, 1999; Halpern, Shikiar, Rentz, & Khan, 2001), more industrial accidents (Ryan, Zwerling, & Orav, 1992), and more injuries (Altarac et al., 2000; Ryan et al., 1992) becomes understandable. Since outcomes such as these have important implications for organizational costs and productivity, and smoking status is known to predict attrition/turnover, we propose that smoking status might usefully complement educational credential and mental ability as a broad index of an applicant's potential organizational contribution and longevity.

In the current article, two types of analyses are presented to illustrate the impact of recruiting smokers into the military. First, we explore the joint association between manpower quality cell (a function of educational credential and mental ability category), smoking, and attrition. While previous studies have documented relationships between tobacco smoking and military attrition, no study has examined this relationship in the context of the military's manpower quality categorization scheme. Second, we conduct exploratory analyses of health and behavior differences between smokers and nonsmokers in the military, as a tool for generating additional hypotheses about why smokers have higher attrition rates. Few studies have explored, in a military population, the array of medical and psychosocial burdens for which smokers are at greater relative risk. This analysis is motivated in part by evidence that smokers have a much wider range of psychological and medical problems than is commonly realized (American Council on Science and Health, 1996).

METHOD

Attrition data were gathered from the Career History Archival Medical and Personnel System (CHAMPS), as described below. Medical and psychosocial conditions were determined by analyzing archival health history data from the Sailors'

Health Inventory Program (SHIP) questionnaire, which is completed by all Navy recruits during inprocessing at the Recruit Training Command (RTC), Great Lakes (Mittelman & Bayer, 1998). Great Lakes is the Navy's only basic training center and all new Navy personnel must thus pass through this site. The SHIP questionnaire is part of a comprehensive medical information system that the Navy has developed and now maintains on its personnel.

Description of Sample

The 134,628 individuals in our sample comprise nearly all recruits who entered the Navy in 1997, 1998, and 1999. Included were 45,193 recruits (approximately 34% of the sample) who were prematurely discharged, 75,727 who were still in the Navy at the time of the analysis, and 13,708 individuals who had successfully completed their first enlistment term and left the Navy at the time of the analysis. The sample consisted of 111,854 males (83%) and 22,774 females (17%), with a race/ethnicity distribution of 56% White, 18% African American, 11% Hispanic, and 14% Other (Asian, Native American, Pacific Islander, or "Other"). The mean age of the sample was 19.8 years at time of entry into training, with a standard deviation of 2.7 years. The majority of individuals were 18–19 years of age (56.0%).

Description of SHIP Questionnaire

The SHIP questionnaire is a self-administered, optically scannable questionnaire that is administered within several days of arrival at RTC. Personnel report their medical and psychosocial history (i.e., events prior to entering the military). SHIP is made up of a short demographic section followed by 191 items assessing medical and psychosocial variables. The vast majority of items are prefaced with the stem, "Have you had or do you have any of the following?" and are presented with a "Yes/No" response format. Some sample items are "Have you had or do you have recurrent back pain?", "Have you had or do you have nervous trouble of any sort?", "Have you had or do you have leg cramps?", and "Have you had or do you have shortness of breath?" The SHIP questionnaire also included 2 "Yes/No" tobacco questions: "DO YOU USE TOBACCO?: Smoke (Yes or No), Chew (Yes or No)." The former question was used to classify participants into smoking/nonsmoking groups. As described above, the items assess preservice tobacco use.

Creation of Database

To create a database of SHIP questionnaire responses (including smoking status) combined with Navy attrition outcomes, SHIP records were cross-referenced (using social security numbers) with records from CHAMPS, a computerized database that combines information from Navy medical and personnel files. Status in-

formation (attrition vs. retention) and mental ability scores were extracted from CHAMPS, as was educational level. SHIP questionnaire responses, age, gender, and ethnicity were extracted from the SHIP data file.

Analyses of Smoking and Attrition

Logistic regression and group comparison analyses were used to determine the joint association of education, mental ability, and smoking with attrition. Educational categories (high school graduates vs. nongraduates) and mental ability categories (upper vs. lower) were created similar to DoD standards, as described next.

Participants were placed into the high school graduate category if they possessed a high school diploma or greater degree; including individuals with some college experience and/or a college degree. The remaining individuals were placed in the nongraduate category, which primarily consisted of individuals with general equivalency diplomas but also included some personnel with adult education school diplomas and other alternative credentials as well as a small proportion with no degree.

Mental ability categories were created by grouping subjects according to their AFQT scores. Individuals with AFQT scores at or above the 50th percentile (64% of the sample)[1] were categorized as "upper mental ability" and individuals below the 50th percentile (36% of the sample) were categorized as "lower mental ability," consistent with DoD standards used for setting recruiting goals.

Combinations of education and aptitude levels also have meaning within DoD. Clearly, personnel with both a high school education and upper mental ability are desirable and are thus targeted by recruiters. Nongraduates and those with lower mental ability are somewhat less desirable but nevertheless make up a significant percentage of the armed forces. Nongraduates must score in the upper mental ability range (AFQT > 50th percentile) to be eligible for military service, and their numbers were restricted by Congress to 10% of new accessions during the time of this research. Individuals with low education and low mental ability are not eligible for service. In summary, to reflect DoD standards, each individual in the study was assigned to 1 of 3 overall "quality" categories: (a) high school graduates in the "upper" mental ability category; (b) high school graduates in the "lower" mental ability category; and (c) nongraduates in the "upper" mental ability category. Attrition was examined as a function of these three groups, as well as smoking/

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[1]The military screens applicants based on AFQT scores, which are calculated as a national population percentile. Congress mandates that no enlistees may come from the lowest 10 percentiles, and that no more than 25% of enlistees can have scores between the 9th and 31st percentiles. Moreover, operational mental ability standards set by the services are often higher than required by Congress. Since AFQT scores in military populations are truncated at the lower end, the majority of recruits score above the 50th percentile of the national population.

nonsmoking status within each group. Due to missing AFQT data in the CHAMPS file, these specific analyses were conducted on a reduced sample (115,820 participants). The distribution of the reduced sample as a function of quality category and demographics is summarized in Table 1.

Analyses of Smoking and Health

Logistic regression analysis was used to identify relationships between smoking and the medical and behavioral health complications assessed by SHIP. However, because many SHIP items have extremely low endorsement rates (i.e., <1.0%), descriptive statistic statistics were first run to identify variables endorsed by at least 5% of the total sample. Variables with lower endorsement rates were subsequently dropped. For each remaining psychosocial and health variable, a univariate logistic regression analysis was performed using smoking status as the independent (predictor) measure. If a significant odds ratio was found ($p < .05$), indicating that smoking was associated with the endorsement of that variable, then the data were examined to determine if the outcome was more common in smokers or more common in nonsmokers. Also, for the logistic regression analyses, 2 continuous variables reflecting exercise frequency and alcohol consumption were dichotomized to allow "high" versus "low" contrasts.

RESULTS

Attrition Analyses

Table 2 shows the distribution of attrition as a function of education, mental ability, and smoking status for the 115,820 cases on which complete data were available.

TABLE 1
Sample Distribution as a Function of DoD Personnel Quality Categories

	Low Education (No Diploma)	*High Education (High School Diploma)*
Low mental ability (AFQT < 50)	Not eligible for service	$N = 36,928$ 81.6% male, 37.5% White 31.9% of final total
High mental ability (AFQT = 50)	$N = 10,979$ 90.4% male 64.8% White 9.5% of final total	$N = 67,913$ 82.5% male 66.2% White 58.6% of final total

Note.   AFQT = Armed Forces Qualification Test.

TABLE 2
Quality Category, Smoking Status, and Attrition

Group	Nonsmokers	Smokers	Row Attrition %
High school grad, upper mental ability	N = 52,057 44.9% of total sample	N = 15,856 13.7% of total sample	29.5
High school grad, lower mental ability	N = 28,101 24.3% of total sample	N = 8,827 7.6% of total sample	33.8
Nongrad, upper mental ability	N = 6,332 5.5% of total sample	N = 4,647 4.0% of total sample	48.1
Total	N = 86,490 74.7% of total sample	N = 29,330 25.3% of total sample	33.6
Column attrition %	29.6%	44.8%	

As can be seen from the bottom row of the table, nonsmokers ($N = 86,490$) had an attrition rate of 29.6%, while smokers ($N = 29,330$) had an attrition rate of 44.8%.[2] Similarly, examination of the far-right column indicates that attrition rates for high school diploma graduates in the upper and lower mental ability categories were 29.5% and 33.8%, respectively, in contrast with an attrition rate of 48.1% for nongraduates with upper mental ability.

Univariate logistic regression analyses indicated that smoking status, education group, and mental ability category were all significantly associated with attrition. Compared with nonsmokers, smokers were 1.93 times more likely to attrite (95% confidence interval [CI], 1.88–1.98, $p < .001$). Compared with individuals with a high school diploma or greater, those without a high school diploma were 2.09 times more likely to attrite (95% CI, 2.02–2.16, $p < .001$). Finally, compared to individuals at or above the 50th percentile in mental ability, individuals below the 50th percentile in mental ability were 1.16 times more likely to attrite (95% CI, 1.14–1.19, $p < .001$).

Table 2 also indicates that the single largest proportion of individuals (44.9%) fall within the category defined by relatively high education, upper mental ability, and nonsmoking status, while the smallest proportion of individuals falls within the nongraduate smoker cell.

To explore the incremental value of smoking as an attrition predictor, a multivariate logistic regression analysis was conducted in which education level and

[2]In addition to the question on tobacco smoking, a separate question on tobacco chewing was asked. Only 3.7% of the sample reported that they chew tobacco. Of these cases, about 94% also reported being tobacco smokers. Thus, the "tobacco smoker" group identified for our major analyses also includes the vast majority of individuals who chew tobacco. Given the small number of individuals who chew tobacco and their overlap with the smoking group, no further analyses of tobacco chewing were conducted.

mental ability level were first entered into a model to predict attrition, followed by smoking status. Holding education and mental ability constant, smokers were 1.80 times more likely to attrite as nonsmokers (95% CI, 1.75–1.85, $p < .001$), indicating that smoking status has significant validity independent of the other factors included in the model. Nearly identical results were obtained when demographics were introduced into the model. Ethnicity (White vs. non-White) and gender were first forced into the model, followed by education level and mental ability level, followed by smoking; in this model, smokers were 1.78 times more likely to attrite as nonsmokers (95% CI, 1.73–1.82, $p < .001$).

Attrition rates as a joint function of education, ability, and smoking are illustrated in Figure 1 Attrition rates for smokers are substantially higher than rates for nonsmokers across all three broad personnel quality categories. Specifically, attrition was 13.0% higher for smokers than for nonsmokers in the high education, upper mental ability category; 15.2% higher for smokers than for nonsmokers in the high education, lower mental ability category; and 11.7% higher for smokers than for nonsmokers in the low education, upper mental ability category.

The figure also shows how several variables interact to influence attrition. For example, examination of the white bars indicates that overall attrition rates are somewhat greater in the lower mental ability portion of the high school graduate pool compared with the upper mental ability portion (33.8% vs. 29.5%, $\chi^2(1) = 206.07$, $p < .001$). When both of these groups are divided into smoking and nonsmoking segments, however, it can be seen that lower ability *nonsmokers* have substantially reduced attrition rates compared with higher ability *smokers* (30.2%
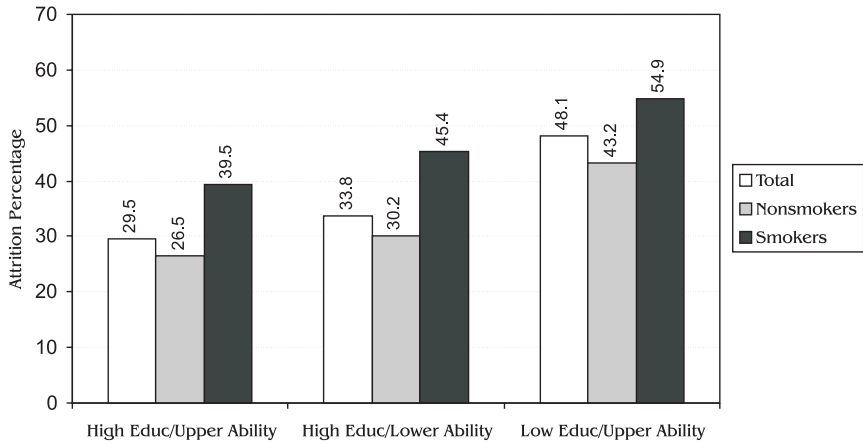

FIGURE 1.   Attrition as a function of education, ability, and smoking status.

versus 39.5%, $\chi^2(1) = 390.08$, $p < .001$). In this specific contrast, smoking status takes precedence over mental ability as an attrition predictor.

Similarly, the overall pool of nongraduates has substantially higher attrition than both the upper mental ability graduates and the lower mental ability graduates (48.1% vs. 29.5% and 33.8%, respectively). Examination of Figure 1 indicates, however, that nongraduates who do not smoke actually have significantly lower attrition than graduate, lower mental ability smokers (43.6% vs. 45.4%, $\chi^2(1) = 5.73$, $p < .05$).

Health and Behavior Comparisons for Smokers Versus Nonsmokers

To better understand sources of attrition differences between smokers and nonsmokers, logistic regression analyses were conducted to compare these groups on health and behavior histories. Table 3 shows the 26 psychosocial and health questions that (a) were endorsed by at least 5% of the total sample, and (b) differed significantly between smokers and nonsmokers. Of these 26 conditions or vulnerabilities, 21 were more frequently reported by smokers and could therefore be useful for generating hypotheses about why smokers have higher attrition rates.

For ease of interpretation, items endorsed significantly more often by smokers were grouped into psychosocial, personal health, and family health categories (see Table 3). As can be seen, the odds ratios reflecting psychosocial differences were somewhat higher than those for other categories. Smokers were more than twice as likely to have cut, burned, or tattooed themselves; to consume relatively more alcohol; to have been suspended or expelled from school; and to report having acted impulsively or without thinking. In addition, smokers were 1.85 times more likely to report acts of petty crime, arson, or animal cruelty; 1.66 times more likely to report relatively low sports participation; and 1.22 times more likely to have been enrolled in special education classes.

Though the personal health items endorsed more often by smokers were somewhat diverse in their content, a number were at least potentially related to allergic reactions and immune system functioning. For example, smokers were 1.51 times as likely to report hives, 1.46 times as likely to report sinus problems, 1.33 times as likely to report allergies, and also more likely to report adverse reactions and allergies to drugs such as penicillin. In addition, smokers were 1.28 times as likely to report cold sores (which stem from viral infections) and 1.11 times as likely to report skin conditions.

Finally, there were a number of family health differences between smokers and nonsmokers. Smokers reported significantly more heart disease, cancer, seizures, and diabetes in their biological families.

While most SHIP items were endorsed more frequently by smokers, the bottom section of Table 3 indicates four items on the SHIP questionnaire that were en-

TABLE 3
Psychosocial and Health Differences Between Smokers (34,884)
and Nonsmokers (99,559)

Variables Higher in Smokers	% of Nonsmokers	% of Smokers	Odds Ratio	95% Confidence Interval
Psychosocial variables				
Cut, burned, or tattooed self	4.3	10.7	2.66	2.54–2.78
High alcohol use[a]	6.4	15.0	2.58	2.48–2.68
Suspended or expelled from school	14.2	28.1	2.35	2.29–2.42
Impulsive, act without thinking	5.4	10.4	2.02	1.93–2.11
Petty crimes, arson, animal cruelty	6.1	10.7	1.85	1.77–1.93
Low sports participation[b]	48.1	60.7	1.66	1.62–1.71
Ever in special education classes	5.8	7.1	1.22	1.16–1.28
Personal health				
Hives	4.7	6.9	1.51	1.44–1.59
Broken bones	15.3	21.3	1.50	1.45–1.55
Sinus problems/sinusitis	6.5	9.3	1.46	1.39–1.52
Ever been in the hospital overnight	15.4	20.3	1.40	1.36–1.44
Have allergies	14.0	17.7	1.33	1.29–1.37
Adverse reaction to drugs/medicines	7.2	9.4	1.33	1.28–1.39
Allergic to penicillin	6.4	8.3	1.32	1.26–1.38
Cold sores on lips or in mouth	6.7	8.4	1.28	1.22–1.34
Blood disorder	10.3	12.6	1.25	1.21–1.30
Skin conditions	6.5	7.2	1.11	1.05–1.17
Family health				
Heart disease in biological family	8.2	11.6	1.46	1.41–1.52
Cancer in biological family	15.3	19.4	1.34	1.29–1.38
Seizures in biological family	6.3	7.3	1.16	1.10–1.21
Diabetes in biological family	14.7	16.2	1.13	1.09–1.17
Vision in both eyes	97.6	96.7	.716	.667–.769
100% recovery from injury	83.2	80.8	.848	.821–.875
Wear glasses or contact lenses	33.4	30.2	.862	.840–.886
Currently receiving medication	5.2	4.6	.870	.821–.922

[a]Alcohol use was assessed on a 4-point scale. For this analysis, low alcohol use is defined as drinking "Never" or "Occasionally," while high alcohol use is defined as drinking "Weekly" or "Daily."

[b]Sports participation was assessed on a 4-point scale. For this analysis, low sports participation is defined as playing sports "Never" or 1–2 times/week, while high sports participation is defined as 3–5 times/week or more.

dorsed more frequently by nonsmokers. Two of these pertain to vision; nonsmokers report slightly (though significantly) more use of eyeglasses or contact lenses and are more likely to endorse an item confirming that they have vision in both eyes. In addition, nonsmokers are 1.18 times as likely to report full recovery from previous physical injuries. Finally, nonsmokers were 1.15 times as likely to indicate that they were currently receiving medications, though the conditions being treated were unspecified.

DISCUSSION

The results of the present study have important implications for both personnel selection in organizations such as the military and for analyses of why tobacco smoking is linked to attrition. With regard to personnel selection practices, our results confirm previous findings (e.g., Gunderson & Arthur, 1969; Knox, 1998; Talcott et al., 1999) that tobacco smoking is strongly associated with military attrition. In addition, however, we have for the first time illustrated the potential value for attrition management of considering smoking status as an explicit personnel quality benchmark in conjunction with education and mental ability.

Under traditional DoD standards, priority is given to recruiting upper mental ability high school diploma graduates, followed by lower mental ability high school graduates. In addition, up to 10% of new recruits per year can be drawn from the nongraduate pool. Since attrition rates increase systematically as a function of these three groups, DoD recruiting policy (particularly the targeting of upper mental ability high school graduates) has seemed empirically sound. Our data suggest, however, that each of the three recruiting categories should be broken into smoking and nonsmoking segments, creating a system of six recruiting categories to replace the current three-category system. This proposal is justified by evidence that nonsmokers and smokers differ substantially in overall attrition (29.6% vs. 44.8% attrition, respectively), and that nonsmokers in "lower quality" cells exhibit less attrition than smokers in "higher quality" cells. For example, among high school graduates, nonsmokers in the lower mental ability category attrite less often than smokers with relatively higher mental ability.

Given these strong relationships between smoking and attrition, establishing preferences for nonsmoking individuals either during recruiting or during job assignment may be justified. In particular, it may make compelling economic sense to route qualified nonsmokers into highly technical, training-intensive jobs where attrition is the most costly.

While there may be multiple reasons for elevated attrition rates in smokers, one major contributor may an elevated prevalence of psychosocial problems. Smokers in our sample were significantly more likely to consume relatively higher amounts of alcohol, a finding consistent with Air Force research showing that smoking is associated with binge drinking (Haddock, Klesges, Talcott, Lando, & Stein, 1998). In addition, smokers were more likely to have been suspended or expelled from school; to report having acted impulsively or without thinking; and to have committed acts of petty crime, arson, or animal cruelty. The current results for psychosocial history items are consistent with previous findings that smokers have poorer mental health (e.g., Black et al., 1999; Gunderson & Arthur, 1969; Johnson et al., 2000; Lasser et al., 2000) and greater problems with substance abuse (Substance Abuse and Mental Health Services Administration, 2001; Tomori et al., 2001). Since other research shows that smokers also have higher rates of absentee-

ism (Burton et al., 1999; Halpern et al., 2001), more industrial accidents (Ryan et al., 1992), and more injuries (Altarac et al., 2000; Ryan et al., 1992), DoD officials should initiate a careful evaluation of costs and benefits associated the proportion of smokers recruited into the armed forces. At present, approximately one third of all DoD personnel smoke cigarettes, a percentage that is very close to the smoking rate in U.S. civilians with sociodemographic characteristics similar to military forces (Bray et al., 2003). The percentage of military smokers has risen slightly in recent years, despite the fact that tobacco cessation is an important component of military health promotion programs and smoking is banned in all DoD buildings (Conway, 1998).

Although the current study replicated previous findings of associations between tobacco use and psychosocial problems, our research design does not allow us to clarify controversial issues of causality. Kendler et al. (1993), for example, used a co-twin control analysis to evaluate whether the link between cigarette smoking and depression is causal or noncausal. Their best-fitting model suggested that the relationship between lifetime smoking and lifetime major depression resulted solely from familial factors, primarily genes that predispose to both conditions. More recent research by Windle and Windle (2001), however, supports a bidirectional model in which smoking and depression reciprocally influence one another, possibly in conjunction with a genetic influence on both outcomes. A study by Dierker et al. (2002) suggests an even more complicated picture in which different mechanisms for comorbidity between smoking and depression exist for different depressive disorders.

Similar uncertainty exists for relationships between smoking and anxiety. For example, researchers have disagreed on whether smoking causes anxiety by inducing neurochemical changes or whether anxiety leads to smoking as part of an attempt to reduce stressful feelings through nicotine self-medication. Though several authors have recently argued for the position that smoking exacerbates stress and anxiety (e.g., Johnson et al., 2000; Parrott, 1999), the issue remains the subject of much controversy (e.g., Wills, Sandy, & Yaeger, 2002). In summary, causality in relationships between smoking and psychosocial problems is an issue that is far from settled (Albers & Bierner, 2002; Orlando et al., 2001). A resolution of these issues is critical to the design of intervention programs, which ideally would emphasize amelioration of the "causal" variable (be it tobacco or psychological distress) rather than the outcome variable.

While the present results do not clarify mechanisms of association between smoking and mental and physical health problems, they do confirm that smokers as a population enter military service with an identifiable burden of psychosocial and health vulnerabilities. Once in the service, they attrite at a markedly higher rate, creating substantial financial losses for the Defense Department (Klesges et al., 2001). These losses are compounded when medical expenses for *retained* smokers are considered. Specifically, Helyer et al. (1998) estimated that smoking

inflates DoD health care costs by $584 million annually and creates an additional $346 million in annual costs associated with lost productivity. Thus, the military experiences inflated personnel costs due to lost recruiting/training investments in smokers who depart early, and inflated medical costs for smokers who stay. The "lose/lose" nature of this outcome indicates that the smoking status of applicants should be considered during the military's personnel recruiting and screening process.

The present study has several possible limitations. First, many analyses were performed to identify associations with smoking, leading to the possibility of Type I errors. However, this would not affect the main analyses relating smoking, AFQT, education, and attrition. In addition, since we have only preservice smoking data, it was not possible to identify individuals who first began smoking after joining the military. The characteristics and performance of these individuals is certainly a matter of interest, however, and worthy of additional research. Finally, since Navy enlisted personnel comprised the entire sample, similar studies should be conducted on personnel from the other services to cross-validate present findings. It is unknown whether demographic differences across services might alter the strength of the relationships reported here.

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14. ABSTRACT (maximum 200 words)

Previous studies indicate that smokers attrite from military service at significantly higher rates than nonsmokers. The purpose of the current effort is twofold: (1) To examine the implications of treating smoking status as a third military personnel quality indicator along with educational credential and mental ability, and (2) to explore preservice psychosocial and health differences between smokers and nonsmokers in support of hypothesis development about reasons for elevated attrition rates in smokers. The results support using smoking status as a personnel quality indicator for recruiting and screening purposes, and indicate that smokers, as a group, enter the military with identifiable psychosocial and physical vulnerabilities.

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